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ABSTRACT

The high percentage of eighth grade students failing the school district's criterion referenced mathematics test was addressed by the implementation of an instructional alignment program. Program goals included test mastery by 75 percent of the targeted population, establishment of practical significance for the approach, and a reduction in test item difficulty through the use of alignment strategies. A handbook was developed and served as the teacher's guide for the classroom program. Instructional materials were located, developed, and correlated to the criterion objectives by the use of reference charts. The objectives were organized into a step by step delivery system through application of a task analysis process. Posttest results indicated mastery of the criterion test by 78 percent of the target group. The approach was found to have practical significance and achieved an effect size of 1.37 over the traditional program. It was concluded that alignment strategies should be applied to all grade levels of the mathematics curriculum to achieve criterion referenced mathematics objectives. This practicum report contains a problem statement, research and intervention methods, results, recommendations, and a list of references. Appendices include a complete data analysis of the problem, interview questions, and posttest results of the intervention. (Author/CW)

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AN INSTRUCTIONAL ALIGNMENT PROGRAM FOR EIGHTH GRADE CRITERION REFERENCED MATH OBJECTIVES

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Thomas J. Ippolito

A Practicum Report
submitted to the Faculty of the Center for
the Advancement of Education at Nova University in
partial fulfillment of the requirements for the degree of
Master of Science.

The abstract of this report may be placed in a
National Database System for reference.

September, 1990

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Abstract

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Descriptors: Curriculum Design/Instructional Design/ Teaching Methods/Mathematics Instruction/Criterion Referenced Test/Task Analysis/Diagnostic Teaching/ Instructional Systems/Mastery Learning.

The high percentage of eighth grade students, failing the district's criterion referenced mathematics test, was addressed by the implementation of an instructional alignment program. Program goals included test mastery by 75 percent of the target population, establishment of practical significance for the approach, and a reduction in test item difficulty through the use of alignment strategies. A handbook was developed and served as the teacher's guide for the classroom program. Instructional materials were located, developed, and correlated to the criterion objectives by the use of reference charts. The objectives were organized into a step by step delivery system through application of a task analysis process. A direct instructional model served as the teaching methodology. Formative testing instruments stressed the diagnostic use of test information throughout the instructional program. Instructional time schedules functioned to control pacing requirements; and inservice activities reinforced program concepts prior to and during the implementation. Posttest results indicated mastery of the criterion test by 78 percent of the target group. The approach was found to have practical significance and achieved an effect size of 1.37 sigma over the traditional program. Test item difficulty was reduced. It was concluded that alignment strategies should be applied to all grade levels of the math curriculum to achieve criterion referenced math objectives. Appendices include a complete data analysis of the problem and multiple posttest results of the intervention. The teacher handbook, which contained all program materials, is included as an attachment.

Authorship Statement

I hereby testify that this paper and the work it reports are entirely my own. When it has been necessary to draw from the work of others, published or unpublished, I have acknowledged such work in accordance with accepted scholarly and editorial practice. I give this testimony freely, out of the respect for the scholarship of other professionals in the field and in the hope that my own work, presented here, will earn similar respect.

Signed: Thomas J. Ippolito

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Table of Contents

	Page
Title Page	i
Abstract	ii
Authorship Statement	iii
Observer's Verification	iv
Table of Contents	v
Chapters	
I. Purpose	1
II. Research and Solution Strategy	16
III. Method	35
IV. Results	47
V. Recommendations	54
Reference List	57
Appendices	
Appendix A: ITBS Scores 1986-1989	63
Appendix B: Percentage of Students Who Master the MSS Test	65
Appendix C: Average Number of Skills Mastered on the MSS Test	67
Appendix D: Objectives Showing Low Group Mastery Percentages	69

		Page
Appendix E:	Interview Questions	71
Appendix F:	Posttest Scores 1990	74
Appendix G:	Posttest Scores for Individual Objectives 1990	76
Appendix H:	Target Group Posttest Results For Outcome Two	79
Appendix I:	Comparison of Groups' Posttest Results on Outcome Two	81
Appendix J:	Posttest Measurements of Practical Significance 1990 . .	83

CHAPTER I

Purpose

Background

The school district in which this practicum was implemented is located in the southeast part of the Phoenix metropolitan area. The district is a K-8 elementary district, serving an upper middle class community, which has high expectations for students, schools, and teachers. Rapid growth over the past 15 years has increased the student population from 600 students to a present enrollment of over 9,000. As a result of the growth, the district has changed from a small closely knit organization, serving the needs of an agricultural community, to a large rapidly expanding district serving a professional clientele. To keep up with the rapid growth, schools have been built on a yearly basis with new teachers continuously being employed. Instructional programs are in a constant state of transition to meet the needs of a growing community. Quickly changing conditions have put heavy demands on district personnel and programs to keep

pace. The situation of rapid growth is projected to continue.

Rapid growth has resulted in a situation where teachers have not worked together for very long as a team. New staff, while often experienced, confront complex instructional programs and district procedures with which they have little familiarity. Achieving a consistent understanding and implementation of instructional programs has been a concern and on going staff development goal. A majority of the teaching staff have received extensive staff development training in Madeline Hunter's Essential Elements of Instruction (EEI) techniques. Staff development efforts are indicative of a strong commitment and emphasis on curriculum and instruction.

A Director of Curriculum is employed to develop a written curriculum for each subject and grade level. The written curriculum is described in a course of study manual which is distributed to all new teachers upon employment. From the written curriculum, priority objectives have been identified and are assessed yearly using a pre-post criterion referenced testing design. Criterion tests are given at all grade levels for the subject areas of math, language, and reading. Teachers

are aware of this but also enjoy a great deal of autonomy within individual classrooms to structure the courses as they wish.

Rapid change has also occurred at the central office resulting in new personnel serving in critical roles. Operational procedures and instructional programs have been subjected to a review and restructuring process. Curriculum and instructional programs have been developed in a broad and general sense. The material resources and classroom instructional guidelines required for a consistent instructional implementation of broad curriculum objectives have not been fully developed. The staff is often confused by the overwhelming number of objectives and exhibit a lack of agreement regarding the focus of the program. Elements needed to provide a quality control for the instructional program are lacking. The result has been fragmentation and inconsistencies in subject matter coverage between classes.

The school in which this practicum was implemented is a junior high school composed of seventh and eighth grades. The school has been operational for four years and has a student population of 900. Pupils are tracked for math into four different levels. Courses

are offered in basic math, general math, pre-algebra, and algebra. The majority of students are placed in general math and a whole group instructional strategy is used. The student body has consistently scored above national norms in math on the Iowa Test of Basic Skills (ITBS). District results exceed state and county norms (Appendix A:63).

The researcher is presently an eighth grade math teacher in the setting described and is responsible for teaching basic, general, and pre-algebra math levels to 150 students daily. Additional responsibilities include serving as a mentor; in which capacity the researcher interacts with the math department staff to plan, assist, and implement improvements in the school's math program. The researcher has been involved with the Director of Curriculum and the school's administration on projects related to these responsibilities. The researcher has daily contact with the target population, monthly meetings with the math department staff, and interaction with administrators responsible for curriculum and instruction. The researcher was in a position to have an influence over changes which were made within the practicum setting.

Problem Statement

The school district's instructional and curriculum philosophies are oriented toward mastery and Outcome-Based theories. Criterion Referenced, or Outcome-Based curriculum design, is a method of ensuring that teachers follow a particular curriculum and students learn a specific set of objectives. The system is meant to provide a curricular focus, give similar content coverage, and establish a baseline of performance and basic competency for all. Criterion design does not place restrictions on the maximum that students may achieve, but does attempt to hold teachers and students responsible for mastery of basic prerequisite skills as an initial requirement. Mastery of prerequisite skills is seen as the foundation for future growth in the subject area. Criterion referenced testing is the evaluation component of this design; which is based on the assumption that in a hierarchically organized subject, such as mathematics, failure to learn prerequisite skills is likely to interfere with the learning of later skills.

The dominant role of prior knowledge to act as a proactive facilitator of new learning, and to serve as a retroactive facilitator for previous learning, was

confirmed by the research of Arzi, Ben-Zvi, and Ganiel (1985). In this study, the authors concluded that the coordination of previous objectives with those to follow enabled the student to better grasp relationships between previous and new knowledge. The authors' findings supported the theory of the student's formation of cognitive abilities established by Ausebel, Novak, and Hanesian (1978). Ausebel believed that each skill laid the foundation for skills to follow and that cognitive structures were built through the consolidation of previous learnings in new situations.

Criterion based instruction permits curriculum to focus on continuity within and between courses. The design allows for sequencing and integration of content on a continuum making use of previous knowledge in new situations. Criterion referenced models are consistent with Ausebel's theory of the formation of cognitive structures. The importance of criterion mastery is obvious as future educational outcomes are dependent on the cumulative effects of previous learnings. Failure to achieve identified learning goals, which lay the foundations for future cognitive structures, limits subsequent achievements.

There was evidence in the practicum setting that priority math objectives were not being mastered by a significant amount of the student population (Appendix B:65). Despite a student body with a good grade point average, above average performance on the ITBS Test, and a low percentage of students who were considered at risk, many students did not demonstrate mastery of the district's criterion referenced math skills. An examination of Math Support System (MSS) records showed that 48.9 percent of the eighth grade student population did not achieve mastery of the criterion referenced math objectives in 1989 (Appendix B:65). Mastery of the objectives was not a problem for the pre-algebra and algebra math tracks as placement into these levels required prior mastery of MSS skills. Since less than 15 percent of the student population received a basic math placement, general math students appeared to be the group most directly affected by this problem. The eighth grade general math track was designated as the target group for the research project.

The problem of criterion mastery also occurred throughout other grade levels of the curriculum (Appendix B:65). Declining results first appeared

after the kindergarten level. The cumulative effects of seven years of poor criterion mastery impacted heavily at the eighth grade level. The failure of eighth grade students to achieve priority math skills was of particular concern. The curriculum at this level laid the foundation for algebra skills at high school. Eighth grade represented the culmination of the math program in the school district. Students transferred to a high school district at the conclusion of the school year. During articulation meetings with high school representatives concerns were expressed that incoming students did not possess the prerequisite skills necessary for high school mathematics.

Causes for the problem encountered by the target group stemmed from a variety of sources. The researcher examined MSS posttesting records and found that an average of 13 out of 20 skills were mastered at the eighth grade level in 1989 (Appendix C:67). Pretesting revealed that students scored a mean of three objectives prior to beginning the program. The improvement represented an average gain of only 10 skills over the course of the school year. Classroom instructional activities did not appear to provide focused coverage for the tested skills.

Criterion mastery also appeared to be impacted by test item difficulty. As previously noted 13 of 20 skills were mastered by the eighth grade students in 1989. The researcher examined records of individual skill mastery percentages and identified seven objectives which were mastered at much lower percentage rates than others (Appendix D:69). Over a period of time group improvement had been significantly smaller on these seven objectives. The objectives seemed to present conceptual difficulties to the age group as a whole. Focused content coverage and test item difficulty appeared to contribute to the problem of criterion mastery. The researcher questioned the instructional program being implemented in the classroom setting.

Shavelson and Stern (1981) found that the written curriculum was often modified by classroom teachers. An interview was used to determine what content was being emphasized in the instructional setting (Appendix E:71). An analysis of the results led the researcher to the following conclusions:

1. The textbook was the implemented curriculum in a majority of the classrooms.

2. Course content, sequencing, and pacing was largely determined by the textbook guidelines.
3. The written curriculum document was not widely used in course planning. Teachers felt it was not useful as an instructional resource guide.

Textbook dominance of the instructional curriculum led the researcher to question the alignment which existed between textbook content and assessment objectives. The researcher examined the textbook and found a poor match between textbook content and tested criterion objectives. The textbook dominated classroom curriculum provided adequate content coverage for only 55 percent of the tested objectives.

The textbook was also examined for pacing and sequencing of the priority skills. The pacing and sequencing strategies did not provide a focus for the tested skills nor allow for the time necessary to master the specific content. Tested objectives were found to be scattered in illogical sequences throughout the textbook chapters. Pacing encouraged the covering of content as opposed to a strategy of teaching to defined objectives for mastery. The researcher found the textbook was not supportive of a criterion

referenced design in pacing and sequencing arrangements.

A textbook driven classroom curriculum, which was not supportive in instructional content, sequencing, or pacing, of a criterion referenced outcome based philosophy, was a significant cause for the problem encountered by the target population.

Teachers relied on the adopted text rather than the curriculum document to provide the needed organization for the instructional program. Teachers felt that the document was not useful as an implementation tool. The researcher analyzed the document using criteria developed by Armstrong and Shutes (1981) and found it to be of less than average quality. The document did not provide any organizational guidelines for implementing its intended outcomes. The document lacked the instructional materials and supplementary resources required to teach to its specific objectives and provided no sequencing or pacing guidelines for the intended user. Reference systems, needed to coordinate the tested objectives, materials, and instructional activities, did not exist. Formative monitoring and evaluation instruments were not provided for. The document was found to be merely

a listing of all curriculum objectives by grade levels. Priority skills were lost in a maze of several other objectives. The researcher concluded that the document provided little guidance for the implementation process.

There were attempts to correct the problem of low student mastery on criterion referenced math tests. The administration tried to hold teachers more responsible for monitoring student progress on MSS objectives throughout the year. Evaluations included questions on what planning and monitoring devices were being used to promote student progress on the criterion skills. Some improvement occurred. A 17.3 percent improvement of the eighth grade students who achieve mastery was noted over a four year period (Appendix B:65). The researcher felt the improvement was the result of administrative efforts to raise the level of concern and focus of the teaching staff. Despite the improvement 48.9 percent of the students were still unable to achieve mastery of priority curriculum math objectives. Little had been done to examine curriculum, materials, or textbooks for quality and alignment. This project attempted to solve the problem

of the eighth grade target group who did not achieve mastery of criterion referenced math objectives.

Outcome Objectives

The researcher set the following objectives for the intervention program:

1. After 12 weeks of math instruction 75 percent of the eighth grade general math target group will achieve mastery of 75 percent of the criterion math objectives as measured by the MSS criterion referenced posttest.
2. After 12 weeks of math instruction, the eighth grade general math target group will score a mean increase of 20 percent, over 1989 posttest results, in the mastery of seven skills identified as conceptually difficult. The results will be measured by the MSS criterion referenced posttest.
3. After 12 weeks of math instruction, the eighth grade general math target group will achieve a group mean which is practically significant, .33 of a standard deviation or larger, over the mean achieved by a comparison group using the present program. The results will be

measured by the MSS criterion referenced posttest.

The use of a comparison group was for the purpose of allowing an analysis to be made between the treatment and the existing program.

The achieving of desired outcomes would ensure that a curricular focus was maintained; and that a larger percentage of the student body was capable of mastering criterion objectives. It would also suggest that item difficulty could be reduced through better curriculum and instructional designs. Should the theoretical goals of outcomes one and two not be realized, achieving outcome three would be a step toward improvement of the existing situation.

The researcher believed it was realistic to expect that three-fourths of the student population could achieve these results. A system which relied on the development of prerequisite skills, as a foundation for future curriculum objectives, required more than one-half of the student population who could master those objectives prior to grade level promotion. Mastery by 50 percent of the population was not considered successful in criterion referenced instructional designs. Should the problem persist any attempt to

pursue the achievement of future goals, without the development of sound prerequisite foundations, would be educationally unsound. Realization of program outcomes would prove that basic math competencies are achievable by a larger percentage of students in a criterion referenced design.

CHAPTER II

Research and Solution Strategy

Curriculum Alignment refers to the conscious efforts of instructional designers to align or correlate the three main elements of a curriculum.

> A curriculum is composed of objectives, instruction, and assessment. When all three match--that is instruction and assessment focus on stated objectives--then the effects of schooling are usually both understandable and impressive. When these three elements are not aligned--that is district curriculum guides state one thing, classroom instruction focuses on something else, and standardized tests reflect neither--then the effects of schooling are difficult to determine and therefore difficult to improve. (Niedermeyer and Yelon, 1981:618)

Curriculum alignment advocates believe a curriculum should determine precisely what it intends to teach, teach that specifically, and test or measure specifically what was taught.

The basic principles for designing a well aligned curriculum have been known by educators for 40 years. The ideas for unifying the elements of the school's curriculum were established by Tyler (1949). The message laid down in his book was, and remains, that

the curriculum must be conceived, structured, and maintained as a whole comprised of independent and dynamically related elements.

Curriculum alignment beliefs have been observed in a wide array of theories and educational programs. Carroll (1963) claimed that effective instruction should give the learner a clear picture of the instructional outcomes. Criterion Referenced Instruction (CRI) called for the identical task to be learned in both the instructional process and the final assessment (Mager & Pipe, 1974). Pipe believed that instructional systems should be designed in a style where the output was fed back as input in order to modify the instructional process. The assessment results were used to adjust the objective, the process, or both, until they equaled the intended outcome. CRI ensured an exact match among what was taught, what was measured, and what was intended to be learned. Though CRI failed to infiltrate instructional practices in public schools, the model was adopted by industry and business as a method for reducing variance. In that setting CRI continued to flourish and be successful (Mager & Pipe, 1983).

Other educators also viewed assessment as a method for improving curriculum and instructional programs (Airasian & Madaus, 1983; Behr, 1982; Popham, 1987).

In the middle 1970's the ideas of task analysis and instructional alignment were applied successfully in the area of remedial education (Resnik, 1976). From 1975 until the present the concepts of alignment have been applied in many teaching-learning programs. The most representative and widely known of these are Mastery Learning (Bloom, 1974), Direct Instruction (Rosenshine, 1986), Essential Elements of Instruction (Hunter, 1982), and Outcome-Based Education (Spady, 1988). All of these programs called for close alignment between outcomes, instruction, and evaluations. Each supported a clarity of instructional focus on outcome objectives.

The success of these methods, in promoting significant student achievement gains, has been well documented by research (Burns, 1987; Guskey & Pigott, 1988; Hyman & Cohen, 1979; Squires, 1987). Fifteen years of classroom use has proven their effectiveness. The effect of CRI was near perfect learning with variation in learning rate rather than amount (Cohen, 1987). Rosenshine (1986) and Brophy and Good (1986)

found that the systematic step by step instructional approach of Direct Instruction enhanced academic growth. The use of a task analysis procedure, to identify the instructional steps of a learning objective, was most applicable to teach the mastery of math procedures and computations (Resnik, Wang, & Kaplan 1973; Simon, 1973). The advantages of the direct instructional model was that it provided for a high degree of interaction, allowed the immediate assessment of conceptual errors, and provided the student with a corrective-feedback problem solving strategy (Simon, 1973). Lysakowski and Walberg (1982) provided research evidence which indicated that the advantages suggested by Simon were significant variables for increased student achievement.

A meta-analysis of Mastery Learning approaches at the junior high school level indicated effect sizes of .94 sigma (standard deviations) on student achievement in favor of Mastery Learning over more traditional approaches (Guskey & Gates, 1986). Lysakowski and Walberg (1982) conducted a study which used the components of Mastery Learning plus effective skills research and reported an effect size of .97 sigma for the approach. Walberg (1984) cited a mean effect size

of .81 sigma in another study of Mastery Learning and traditional instructional approaches. Bloom (1984a) claimed an effect size of 1.00 when Mastery Learning strategies were applied as intended. Bloom (1984b) cited research which indicated that Mastery Learning, in combination with other variables, was capable of increasing achievement by 1.00 to 1.50 sigma.

Cohen (1987) believed that all these successful methodologies used curriculum alignment as a common element. The term "instructional alignment" was used by Cohen (1987:17) to refer specifically to the fine tuning demands of the task analysis process as applied to the instructional component of the curriculum. Cohen suggested that the instructional process required a precision which necessitated identifying the steps required to master an objective, as well as organizing the proper sequencing of the steps involved. Cohen (1987) theorized that outcome driven instructional designs, like those found in Mastery Learning, Direct Instruction, and the techniques of Madeline Hunter, generated more aligned instruction than traditional approaches did, which accounted for the significant student achievement gains reported.

Cohen (1987) reported the results of four doctoral studies which demonstrated the effect aligned instruction had on student achievement. The studies also provided evidence of alignment effects on learning rates, initial aptitude differences, and task difficulty.

According to Cohen, the results of the Koczor (1984) study showed that even minor misalignment between instruction and testing produced 40 percent differences in posttest raw scores. The Koczor (1984) results also indicated much better achievement for high aptitude students under aligned conditions than under misaligned conditions.

The Tallarico study (1984) demonstrated that learning rate differences could be reduced through testwiseness instruction for low achievers. Instructional alignment and testwiseness instruction produced a 1.3 sigma effect on posttest performance of students with lower aptitudes. Testwiseness instruction was successful in reducing learning rate differences and posttest score variance.

The Fahey (1986) study concentrated on alignment effects relative to task difficulty and aptitude differences. Using an instructional alignment program

produced a 1.2 sigma effect on student achievement. Both high and low aptitude groups achieved significantly less under misaligned conditions. This suggested that alignment was equally important for all types of student aptitudes. The Fahey (1986) results also indicated that the effects of misalignment were lower when learning tasks were easy. As task difficulty increased alignment became more critical to student achievement.

Elia (1986) studied the effects of alignment with low achievers. Results indicated an alignment effect of .91 sigma on student achievement.

The research of Koczor (1984), Tallarico (1984), Fahey (1986), and Elia (1986) supported the importance of instructional alignment for all students and illustrated the effects of misalignment on achievement.

Methodologies based on the ideas of alignment have critics. Opponents claim that the methods are restrictive and constitute nothing more than teaching to the test (Slavin, 1987). Slavin (1987) felt that whole group mastery learning strategies achieved a reduction in variance by severely limiting the instructional content and controlling pacing until near perfect learning occurred. Concerns appeared to be

directed toward learning rate and aptitude differences. Slavin believed that individual student differences, on these two variables, resulted in the adjustment to a slower learning pace as the solution for achieving high group mastery. Slavin objected to Mastery Learning only as it was applied to a whole group teaching strategy and not to the concept of instructional alignment "itself". Spady (1988) addressed concerns over individual learning differences when he suggested that schools needed to reorganize instructional programs and time structures to accommodate the philosophy of an outcome-based system. Educators agree that effective instruction demands congruence between the instructional and assessment components. F. W. English, as quoted by Mathews (1983:248) stated:

> ...Students should not be expected to do well on norm-referenced standardized tests (or any other tests) if the prescribed and taught curriculums do not account for the concepts and skills being evaluated by the tests!

Cohen (1987:19) answered critics when he stated:

> Presently we find no other construct that consistently generates such large effects, which is probably why the idea of instructional alignment is so well-entrenched in the conventional wisdom of instructional designers, even if not in the programs currently found in most classrooms.

Research by the Educational Products Information Exchange (EPIE) Institute showed that the textbook determined the curriculum 90 percent of the time in classrooms studied (EPIEgram, 1987). EPIE studies also indicated that textbooks commonly covered only 50 percent of the curriculum objectives school districts had selected as goals for each grade level. The EPIE Institute reached the following conclusions as a result of its research:

1. The textbook often does not align with curriculum outcome intentions.
2. The textbook often is incapable of meeting all objectives of the prescribed curriculum.
3. The textbook often is the defacto curriculum in a majority of classrooms as it determines what content will be taught and what experiences learners will have.

EPIEgram (1987:3) summarized:

> In too many schools once major materials have been selected, the assumption is made that the needed organization of the curriculum has been achieved if teachers and students simply follow the organization of those materials. EPIE's recent research on curriculum alignment shows this to be a striking false assumption, particularly in regards to textbooks.

Other research supported EPIE's findings in this area (Cotton & Savard, 1982; Freeman, Kuhs, & Porter, 1983; Komoski, 1990; Mehrens & Phillips, 1986).

Porter (1988) and Freeman and Porter (1989) conducted research which showed how teachers used textbooks. Results indicated that a teacher's own convictions guided content decisions about what to emphasize and what to skip from the textbook content available. Content often differed substantially among classrooms who relied on the same textbook. Research implications appeared to be that by following the textbook teachers almost certainly deviated from the expected curriculum. While studies indicated a 50 percent match between textbook content and curriculum objectives this may not be achieved due to individual teacher's decisions on how to use the content.

Alignment projects, implemented in other school settings, were examined to provide insight about their elements. Niedermeyer and Yelon (1981) described a project by the Los Angeles Unified School District, in collaboration with the Southwest Regional Laboratory for Educational Research and Development (SWRL). The purpose of the Los Angeles project was to align classroom instruction with other elements of the

curriculum. Efforts began with a district recognition that teaching to specific skills required the use of multiple materials. Program directors felt that a single textbook provided insufficient content coverage and efforts were begun to develop and locate the materials needed to teach to objectives not addressed in the textbooks. A philosophy of selective use of materials was adopted. It was found that teachers needed assistance to implement this philosophy. Teachers required help in matching instructional materials and activities with essential skills. Teachers also needed directives on how to proceed through the textbook and supplementary materials. Help was provided through the development of charts which correlated all instructional materials with the essential skills. The correlational charts provided sequencing directives on how to use the materials. Yearly and weekly instructional schedules were developed to guide the use of instructional time. The time schedules ensured that content coverage and pacing requirements were followed. A group and individual formative monitoring system was used to monitor progress and adjust teaching strategies during implementation. Niedermeyer (1977) found that teachers

needed help in adjusting instruction from a style based on covering textual materials to one based on teaching to defined objectives. Inservice was given to teachers on teaching to defined objectives and interpreting monitoring data in a diagnostic manner.

A district project, based on the ideas of curriculum alignment, was implemented in Red Bank, New Jersey (Abrams, 1985). The goal of the program was to raise standardized math scores. Extensive supplementary materials were developed to support the tested objectives. Instruction focused on these materials and used a district developed monitoring system to provide feedback on group progress during implementation. Results over a five year period indicated that eighth grade math achievement rose from a mean of 8.0 to 12.2. The district's superintendent stated, "The process of curriculum alignment--teaching what was to be tested and testing what we taught--proved to be a significant factor in improving instruction" (Abrams, 1985:31).

Yarworth, Schwambach, and Nicely (1988) described a mathematics improvement program, based on the concepts of curriculum alignment, which was implemented in the Muhlenberg Pennsylvania School District during

1982-1983. A taxonomy and reference system was developed to assist teachers in locating, selecting, and matching instructional materials to tested objectives. Textbooks and all supplementary materials were coded with the taxonomy. An Instructional Resource Guide was developed to assist teachers in selection of available instructional materials. The guide functioned as an action document directing teachers in the use of the materials (Nicely, 1986). Instructional planning schedules were developed and used as courses of study for the program. The program also featured the district development of a monitoring system that was used in a formative sense to document individual and group progress. Teachers received training on the use of the materials and taxonomy. Training was provided through inservice prior to beginning the project. Inservice also concentrated on analyzing assessment results in a diagnostic manner. Results of the program indicated that the percentage of students failing the basic skills test was reduced at all grade levels. Results at eighth grade for the 1986-1987 school year showed 90 percent student mastery of the basic math skills.

Mathews (1983) described what the three curriculums should consist of to achieve alignment. The prescribed curriculum should include written performance objectives, specification of content, teacher and student instructional activities, objective-based resources, and methods to assess student and program results. The taught curriculum should include a program guide which organizes the resources needed for teaching to the defined skills and serves as the basis for the development of daily lesson plans and courses of study. To be maximally effective the process should be monitored by administrators. Classroom supervision and evaluations should be geared toward determining the extent to which the curriculums match. The tested curriculum should include both formative and summative instruments which match the prescribed curriculum goals. Formative assessment data should be used in a diagnostic manner to monitor progress and adjust instruction during the instructional implementation. Summative information should be used to modify or change the prescribed curriculum.

Mathews (1983) believed that by applying these principles curriculum variance could be reduced and

the present curriculum document was of less than average quality, and did not provide the resources or organizational guidelines needed for classroom implementation purposes.

Research had indicated that teaching to specific criteria required the use of multiple instructional materials to support the tested objectives not found in the adopted textbook (Abrams, 1985; Niedermeyer & Yelon, 1981). The solution strategy involved locating and developing instructional/practice materials for all tested objectives. The process of locating and developing instructional materials was necessary to ensure that coverage was available to focus on all criterion objectives.

The solution used the following strategies to organize the handbook materials:

1. Task analysis of the criterion objectives to assist with the development of a sequential step by step direct instructional teaching methodology.
2. Organizing the objectives into four instructional units which provided for the sequencing of objectives on a continuum and

the utilizing of prior knowledge in new situations.

3. Development of reference charts which correlated all instructional/practice resources to the criterion objectives and provided directives on how to proceed through the materials.
4. Designing formative unit testing instruments which matched the instructional objectives and could be used in a diagnostic manner throughout the classroom implementation process.
5. Development of a formative diagnostic monitoring system to provide feedback on individual and group progress for each instructional unit.
6. Designing instructional time schedules to guide pacing allocations for each instructional unit.
7. Development of ample isolated and cumulative independent practice exercises for all criterion objectives.

Mathews (1983) suggested that administrative monitoring was necessary for maximum alignment

curriculum alignment achieved. Mathews summed up the central idea of curriculum alignment advocates when he stated, "Teacher and student activities are a deliberate attempt to facilitate the successful performance of the pre-identified objectives" (Mathews, 1983:249).

The solution strategy concentrated on the preparation of an instrumental alignment handbook to provide the materials and organization needed for the classroom implementation of the criterion math objectives. Mathews (1983) had stated that the taught curriculum should include a guide which organized the resources needed to teach the defined skills and functioned as a course of study document for lesson plans. Nicely (1986) had found that instructional guides were useful in directing teachers in the selective use of instructional materials. Niedermeyer and Yelon (1981) found that teachers required assistance and directives on how to selectively proceed through instructional materials. Causes for the problem encountered by the target group indicated teacher over-reliance on a single textbook which had a poor content, pacing, and sequencing correlation with the tested criterion objectives. Evidence existed that

effectiveness. The researcher in his role as mentor monitored the implementation process as part of the solution strategy. Meetings were conducted between the researcher and participating teacher after the conclusion of each instructional unit and at the culmination of the treatment program.

The literature review suggested that the concepts of teaching to defined objectives, selective use of instructional materials, and assessing formative testing data in a diagnostic manner, were critical features of criterion instructional designs. Alignment programs implemented in other settings provided inservice activities in these areas both prior to and during the instructional alignment programs. The problem in the setting suggested that teachers were used to a strategy of coverage of materials. A variety of instructional materials were neither available or used in a selective manner. There was little evidence to suggest that data was being interpreted in a diagnostic fashion to improve instructional effectiveness. Inservice activities were used as part of the solution strategy to introduce these concepts. Reinforcement of inservice concepts occurred through

the monitoring meetings held after the instructional implementation of each unit.

The researcher felt that this strategy would provide the needed focus and organization for priority criterion math objectives. The achievement of the stated outcomes would result in substantially improved student mastery and represent significant progress toward solving the problem in the practicum setting.

CHAPTER III

Method

Implementation of the practicum was conducted according to the following procedure.

The primary task was the instruction of 20 criterion referenced math skills to students in an eighth grade general math group. District pretesting procedures had placed the students into the general math track and no additional pretesting was conducted by the researcher. The group was organized into a target group of 102 students. The target group consisted of four classes under the direction of one participating teacher. A comparison group was organized of 128 students. The comparison group consisted of four classes under the direction of three participating teachers. The researcher believed that equivalent groups existed and that pretreatment performance differences were unlikely.

The researcher designed a handbook which served as the teacher's guide for the classroom implementation of the instructional alignment program. The need existed

to develop a curriculum resource which would provide the organization required for the instructional implementation of the tested objectives.

Research had indicated that teaching to specific criteria required the use of multiple instructional materials. Analysis of the problem had revealed an over-reliance on one textbook; which had a poor content match to the tested objectives. The researcher examined a variety of math textbooks to locate instructional materials for the tested criterion objectives not found in the adopted textbook. The researcher developed instructional materials for objectives which could not be located in supplementary textbooks. The process of locating and developing instructional materials was necessary to ensure that instructional content was available to emphasize all the tested objectives.

The materials were organized into an instructional delivery system. Components of a direct instructional model, suggested by Gersten and Carnine (1986), were chosen as the preferred approach. Research had indicated that a direct instructional approach enhanced academic growth, and was most applicable to teaching the mastery of math procedures and computations

(Brophy & Good, 1986; Rosenshine, 1986; Simon, 1973). The instructional model was highly interactive, and provided the teacher with a format for anticipation, immediate feedback, and pre-assessment correction of potential student errors. This was consistent with the need for ongoing diagnostic information suggested by the review of alignment projects implemented in other settings.

The step-by-step instructional delivery, called for in a direct instructional design, made it essential to conduct a task analysis of the instructional objectives. Cohen (1987) had suggested that instructional alignment demanded the precision found in task analysis. The researcher task analyzed the instructional objectives and organized them into a sequential step-by-step delivery. The task analysis procedure also assisted with the sequencing of the objectives into four instructional units consisting of five skills per unit. In this manner, it was assured that earlier program objectives served as prerequisite skills for later program objectives.

Instructional alignment demands the proper sequencing of skills on a continuum. The sequencing which resulted from the use of the task analysis

process provided for the use of prior knowledge in new learning situations. Arzi, Ben-Zvi, and Ganiel (1985) had proven that prior knowledge could assist with new learning and facilitate previous learning. The sequencing of the instructional objectives was consistent with the theory of the student's formation of cognitive structures developed by Ausebel, Novak, and Hanesian (1978); which suggested that cognitive structures were built through the consolidation of previous learnings in new situations. Task analysis proved to be a critical element for the organization of the instructional materials.

The model used for the instructional delivery system also called for the availability of adequate practice materials, and the use of cumulative practice exercises. Practice exercises were developed for all of the tested objectives. Isolated practice exercises were constructed which focused on only one learning objective. They were included for use after the presentation of the objective. Cumulative practice exercises were designed for use after the unit skills were practiced in isolation. The practice materials were constructed to be an exact match to the instructional objectives and the tested unit skills.

Research had shown that teachers often needed help with matching instructional materials to the tested skills (Niedermeyer & Yelon, 1981). The researcher designed reference charts to illustrate the organization and correlation of the available instructional/practice materials to the tested objectives. Reference charts were intended to encourage selective use of the instructional materials. These charts were also meant to provide the teacher with guidelines on how to proceed through the materials. The tested objectives found in the adopted textbook were also referenced on the charts. Notations were made when the textbook practice materials were not congruent with the tested objective. Notations were also used to indicate that the textbook's instructional treatment of the skill did not fully develop the objective as tested. The handbook reference charts provided guidance on all instructional and practice materials pertinent to each program objective.

Alignment projects reviewed in other settings all used formative assessment to provide information on student progress. There was a need for formative testing instruments in the practicum setting. Four formative unit tests were constructed for use with the

program. The tests were identical in format to the district MSS test and were included in the handbook for use at the end of each instructional unit. The test design featured a multiple choice answer format which was tied specifically to errors in the objective's concepts which were stressed in the instructional delivery. Incorrect answer choices were designed to assist in diagnosing what step of the solution process was in error. The tests were written in a style which facilitated the recording of their results on to class monitoring charts. The first four test problems corresponded to the first unit objective, the next four to the second unit objective, and so on. The test problems were carefully constructed to be a perfect match with the practice exercises and the instructional examples.

The diagnostic use of test information was an important aspect of alignment strategies reviewed. A record keeping system specific to the criterion objectives was needed in the setting. The researcher developed monitoring charts to record the results of each unit test. The system was designed to provide the teacher with a class profile for mastery of each unit objective, as well as an individual record of each

student's progress and needs. A monitoring chart was included in the handbook for each instructional unit.

Instructional time schedules had been a component of the alignment project used by the Los Angeles Unified School District (Niedermeyer & Yelon, 1981). Time schedules were used to assist the teacher in planning the allocation of instructional time. Program pacing requirements were controlled through the use of instructional time schedules. The researcher determined the unit time allocations, developed the time schedules, and included them in the handbook. Research had shown a faster pace was associated with greater learning (Brophy, 1979), and a three week limit was established for the completion of each instructional unit.

The design of the handbook was considered critical to the success of the treatment. The researcher felt the design had to incorporate all the basic elements of an instructional alignment philosophy. The document was the implementation tool which the teacher would use to deliver the program. The construction of the handbook ended with the writing of a program overview, a description of the lesson/unit organization, and a summary of how to use the testing instruments and the

monitoring system. These were included in the front of the handbook to assist the teacher; and to provide a statement about the intent, function, use, and audience for which the handbook was intended.

After the handbook was completed, inservice activities were conducted. The activities were completed within a two hour time period which was much quicker than originally anticipated. Introductory activities focused on the general idea of instructional alignment programs and the philosophies which underlie the belief. The critical features of teaching to defined objectives, selective use of instructional materials, and using formative assessment data in a diagnostic manner, were defined and contrasted with traditional textbook approaches. The handbook materials were distributed and activities were conducted to familiarize the teacher with the contents. The activities stressed the task analysis breakdown of the instructional objectives, the materials reference charts, the independent practice exercises, the four formative testing instruments, the diagnostic monitoring system, and the unit time schedules. Examples of how the handbook design incorporated the essential curriculum alignment philosophies were

illustrated. The researcher stated that decisions regarding classroom management, organizational techniques, how many of the practice materials to use, and how much time to spend on each unit objective, were left to the discretion of the individual teacher. The roles and responsibilities of the participants were defined. A question and answer period was conducted as a closure activity. The researcher felt confident that the program's philosophies, implementation procedures, and usage of the handbook components were understood.

The classroom instructional implementation was carried out over a 12 week period. The process was monitored through a series of four meetings which occurred over the course of the implementation. The researcher conducted a meeting at the conclusion of each of the instructional units. Once the instructional segment of the unit was completed, the teacher administered the formative unit test. The tests were graded and recorded on the diagnostic monitoring charts. A meeting was then held. Unit tests results, diagnostic implications, and instructional adjustments were discussed at the meetings. Organizational problems with use of the program and handbook materials were also reviewed and

solutions to the problems were suggested. The meetings functioned as a monitoring tool for the implementation process, and as a clinical supervision type of reinforcement for the inservice activities. Problems with the materials were minor and solutions involved merely pointing out organizational features of the handbook and correcting problem and answer errors in the materials.

The monitoring charts proved extremely useful in developing instructional strategies. The teacher felt the diagnostic system provided a better understanding of both individual and classroom aptitude and achievement. The information resulted in classroom organizational modifications which included the use of more small heterogeneous groupings, the use of a peer tutoring system, and less instructional/practice time being devoted to the teaching of the whole class as a unit. Diagnostic test information assisted with the organizational arrangement of classroom instructional/practice time toward a more efficient use of the available resources and time schedules.

Reorganization of allocated time proved necessary because of pacing problems which occurred throughout the classroom implementation of the program. The time

allocated for completion of unit objectives appeared adequate for slightly above average to above average abilities. Students with average to slightly below average aptitudes appeared to require more time to fully master the objectives. The predetermined pacing guidelines were subject to learning rate differences. The diagnostic monitoring system alerted the researcher to this situation; and the reorganization of classroom instructional/practice designs was a response to the pacing concerns. All of the instructional units were completed according to the program's suggested time schedules.

After the conclusion of the last instructional unit, the researcher administered the summative posttest to the target and comparison groups. The test was designed by the researcher and measured all 20 criterion math objectives found on the district MSS test. The researcher graded the posttests, recorded the results on class monitoring charts, and evaluated the data in relationship to the program's success criteria.

The implementation ended with a post program meeting. Summative program results were reviewed, implementation problems discussed, and future

modifications determined. The participating teacher expressed satisfaction with the results and felt the program was beneficial. The teacher felt the handbook was a useful classroom tool. The monitoring meetings, held after the completion of each instructional unit, had solved most of the implementation problems and concerns. However, the participating teacher suggested feeling rushed to complete the program within the 12 week time frame. The reorganization of classroom instructional/practice time, which had been used as a response to pacing concerns during the implementation, had not completely solved the problem. The pacing, as originally designed, seemed to be influenced by learning rate differences more than had been anticipated. The time required by all students to successfully master the criterion objectives appeared to be in the 12 to 16 week range. The researcher suggested that for future implementations the pacing allocations should be extended and unit time schedules adjusted accordingly. The time required for completion of the program was changed from 12 to 16 weeks.

CHAPTER IV

Results

The program results were evaluated using a posttest which was designed by the researcher. The posttest was identical in format and content to the district MSS test. The researcher administered the posttest to 230 eighth grade general math students following a 12 week instructional alignment program. The tests were graded and evaluated by the researcher. Evaluation was based on a descriptive statistical method and involved the calculation of percentages, the arithmetic means, and the standard deviations, of the target and comparison groups. Interpretation of the data was made against the outcome objectives established for the practicum. The use of target and comparison groups allowed more specific analysis to be made regarding the effectiveness of the treatment.

Outcome One

The goal for Outcome One was to achieve a test mastery of 15 or more objectives by 75 percent of the

target group. The number of students who mastered 15 or more objectives was calculated. The number was compared against the total target group population and the resulting fraction converted into a percentage. The target group mastery percentage was then compared against the success criteria of 75 percent mastery established for Outcome One. Results indicated that 78.4 percent of the target group achieved mastery of 15 or more posttest objectives (Appendix F:74). Over three-fourths of the target group demonstrated mastery of the district established criteria using the instructional alignment program. Twenty-one and eight tenths percent of the comparison group, which used the existing program, demonstrated mastery of the criterion math objectives (Appendix F:74).

Posttest results for individual objectives indicated that the target group out performed the comparison group on all criterion objectives (Appendix G:76). The researcher concluded that 75 percent of the general math population was capable of achieving district math criterion objectives. The instructional alignment program produced superior results to those achieved by using the existing program. The success

criteria established for Outcome One was fully achieved.

Outcome Two

The researcher was concerned with the difficulty level of seven tested objectives. The objectives had been identified through teacher interview results as being conceptually difficult. Four years of district posttesting had indicated lower group mastery percentages for these seven objectives (Appendix D:69). Smaller amounts of improvement had occurred for the skills. The researcher believed that the instructional alignment program was capable of raising the group mastery percentages, for each of the seven objectives, by 20 percent over the previous year's performance, and established this as the success criteria against which Outcome Two would be measured.

Posttest data was evaluated by the researcher to determine how many of the target group members mastered each of the seven objectives. The evaluation resulted in a mastery percentage for the seven individual objectives. The mastery percentages were compared against the previous year's results and observed for improvements of 20 percent or more. The target group

improved on each one of the seven objectives over the previous year's performance (Appendix H:79). The percentage of improvement ranged from 1 to 55 percent for the objectives. However, only three of the seven objectives showed increases in group mastery percentages of 20 percent or more. The researcher concluded that at least four of the criterion objectives were subject to test item difficulty. Only two of these four objectives showed insignificant improvements and the instructional alignment program had improved results significantly for five of the seven objectives.

The posttest results for the target and comparison groups were analyzed for the seven objectives to determine the degree of difference between the programs. Fahey (1986) had suggested that alignment became more critical as task difficulty increased. The posttest differences were substantial with target group mastery percentages far exceeding comparison group results on each of the seven objectives (Appendix I:81). The researcher concluded that while the goals of Outcome Two had not been fully achieved, the alignment program had reduced test item difficulty and improved student achievement on difficult test objectives.

Outcome Three

Outcome Three had been constructed to allow a measurement of practical significance to be made regarding the posttest score differences between the target and comparison groups. The success criteria established for Outcome Three was to achieve program results which were practically significant. Practical significance was defined as a difference in group means of .33 of a standard deviation or larger.

The researcher evaluated the posttest data to establish the mean and standard deviation for the target and comparison groups. The difference in group means divided by the larger standard deviation of the comparison group resulted in a 1.37 standard deviation difference (Appendix J:83). The difference was well above the figure needed to establish practical significance, and the success criteria established for Outcome Three was fully achieved. The effect size was consistent with the 1 to 1.50 sigma achievement advantage claimed by Bloom (1984a) and other research studies of outcome-based instructional designs.

The effects of the instructional alignment program were further illustrated by a raw score comparison of the posttest score distributions (Appendix F:74). The

scores achieved by the target group showed a small amount of variability and a high percentage of success. Comparison group scores were consistently more scattered and varied with much less success against a set criteria. Comparison group scores were centered around a mean which fell short of criterion mastery. Target group results were skewed above the mastery criteria which was consistent with results expected from a mastery learning design. The target group mean of 16.3 skills mastered was superior to 82.8 percent of the comparison group scores. The researcher concluded that the instructional alignment program produced practically significant results which offered realistic potential for improvement of the existing problem.

Conclusion

The intervention program effectively demonstrated the positive effects of aligned instruction on student math achievement. The realization of Outcome One suggested that criterion mastery could be achieved by at least 75 percent of the eighth grade general math population. While Outcome Two was not fully achieved, the instructional alignment approach successfully reduced test item difficulty and produced far better

results on difficult test objectives than had the present program. The student achievement gains were practically significant offering a solution to the problem of low student mastery of criterion referenced math objectives.

CHAPTER V

Recommendations

This practicum has proven the need for an instructional alignment approach in teaching the criterion referenced math skills which appear on the school district's MSS test. The following recommendations are included:

1. Implement the handbook materials and treatment design in the math program currently found in all eighth grade general math classrooms.
2. Mastery of MSS objectives should be designated a curriculum priority before pursuing other course objectives.
3. Base initial course grades on the summative results of the prescribed criterion objectives.
4. Develop similar objective based materials and alignment programs for all grade levels throughout the math curriculum.
5. Administrative supervision should include more of an emphasis on the degree of congruence

occurring between the prescribed and taught curriculum elements.

6. Restructure allocated instructional time and course designs for the purpose of mastering priority criterion math objectives in the outcome based system.
7. Extend the present handbook materials to include hands on, problem solving, and higher level cognitive skills type problems.

Criterion based curriculum requires the selective use of instructional materials. No single textbook is capable of providing content coverage, pacing, and sequencing demanded by such a design. When curriculum is developed independent from the adopted textbook, the prescribed, taught, and tested curriculum elements must be organized and congruent to achieve the desired educational outcomes. To prevent over-reliance and textbook dominance of the taught curriculum, content must be specific, instruction focused, and a variety of objective based materials organized and made available for classroom use. Program guides which focus on instructional coverage, pacing allocations, and sequencing of skills are required.

Diagnosis is critical to student achievement. Instructional strategies which utilize corrective feedback methods, as well as the use of test results in a diagnostic fashion, are preferrable. Formative testing instruments, specific to the criterion objectives; and monitoring systems, sensitive to individual and classroom needs, are required.

Student mastery of specific criterion objectives requires a precise organization of instructional content, pacing, and sequencing of skills. Alignment programs can provide a successful approach to this need. Curriculum variance can be reduced and student criterion mastery improved through the use of alignment strategies.

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Appendices

Appendix A:

ITBS Scores 1986-1989

Appendix A

A Comparison of District Scores on the Iowa Test of Basic Skills for Years 1986-1989

Grade	7				8			
Year	1986	1987	1988	1989	1986	1987	1988	1989
National	51	51	50	50	48	48	48	48
State	46	51	51	47	48	50	50	46
County	49	54	55	51	50	52	54	54
District	54	64	64	56	59	62	60	54

Note: The scores reflect the mean percentage rank for the total Math Battery on the standardized test.

Appendix B:

Percentage of Students Who

Master the MSS Test

APPENDIX B

Percent of Students Mastering More than 75 Percent of Grade Level Math Objectives on District MSS Evaluation 1986-1989

Grade Level	1986	1987	1988	1989
K	89.9	81.9	91.5	95.5
1	75.5	83.1	80.9	85.9
2	67.9	79.4	78.2	81.4
3	48.6	59.9	66.6	69.0
4	47.4	61.6	57.0	68.0
5	41.9	42.3	49.6	56.2
6	42.8	55.4	51.0	46.3
7	25.4	7.5	38.9	35.2
8	33.8	30.7	43.6	51.1

Appendix C:

Average Number of Skills Mastered on the MSS Test

Appendix C

Average Percent of Skills Mastered on MSS Evaluation 1986-1989

Grade Level	1986	1987	1988	1989
K	82.5	86.2	91.5	93.8
1	80.0	85.6	84.4	87.5
2	80.0	86.0	85.3	86.7
3	68.9	76.3	79.5	80.0
4	67.3	75.5	74.5	68.0
5	61.4	64.3	67.2	71.9
6	61.0	69.5	66.5	65.0
7	52.0	39.2	60.4	58.8
8	52.5	53.5	60.5	64.4

* Eighth grade pretest results for 1989 showed a mean mastery of three objectives prior to beginning the eighth grade math program.

** A 64.4 skill mastery for the eighth grade level in 1989, represents 13 objectives.

Appendix D:

Objectives Showing Low Group

Mastery Percentages

Appendix D

MSS Objectives Showing Lower Group Mastery Percentages

Skill	% of Mastery for 1989	Improvement Over a 3 Year Period
1. Absolute Value Equations	48%	26%
2. Rational Number Equations	54%	17%
3. Solving Inequalities	32%	19%
4. Volumes of Prisms, Cubes, and Cylinders	54%	19%
5. Solve word problems using equations	49%	12%
6. Solve word problems with sales tax and discounts	52%	11%
7. Compute mean, median or mode for a set of numbers	49%	18%

* These skills were also identified by a majority of math teachers as being conceptually difficult.

Appendix E:

Interview Questions

Appendix E

Interview Questions

1. What is the instructional resource you rely on most to determine your course content?
2. How do you determine the sequence by which you teach your course content?
3. What determines the pacing arrangement you use for coverage of your course content?
4. What evaluation tools do you use to determine course mastery?
5. Do you proceed through the textbook in a chapter by chapter sequential order?
6. Do you omit and/or add materials to the textbook? If so, what do you omit and/or add?
7. Do you rely on the textbook tests and practice exercises for evaluation and homework purposes?
8. What do you do to develop the MSS skills in your course?
9. Do you believe there are adequate practice materials, instructional resources, and testing instruments to support the instructional implementation of the MSS objectives in your classroom?

10. How do you determine what textbook content is of a priority nature?
11. Do you have a class monitoring system which allows for specific tracking of class and individual progress on your course objectives? If so, could you explain how it works? Do you monitor all course objectives? If not, which objectives do you monitor for progress?
12. Do you feel the district curriculum course of study manual is helpful to you in organizing and planning course content? Why or Why not?
13. Do you feel that some MSS skills are more difficult for students to master than others?
14. Would you list the seven MSS skills which you feel are the most difficult for students to master?
15. Is the district curriculum course of study manual a major resource for you in planning the design (pacing and sequencing) for your course?

Appendix F:

Posttest Scores 1990

Appendix F

Raw Score Comparison of Target and Comparison Group Posttest Distributions

Raw Score	Target Grp.	% of Target Grp.	Comparison Group	% of Comparison Group
20	11	10.8	0	0.0
19	13	12.7	1	.8
18	14	13.7	2	1.6
17	17	16.7	10	7.8
16	16	15.7	9	7.0
15	9	8.8	6	4.7
14	6	5.9	8	6.2
13	4	3.9	10	7.8
12	5	4.9	17	13.2
11	3	2.9	13	10.2
10	1	1.0	12	9.4
9	1	1.0	16	12.5
8	2	2.0	8	6.3
7	0	0.0	3	2.3
6	0	0.0	7	5.5
5	0	0.0	1	.8
4	0	0.0	3	2.3
3	0	0.0	2	1.6
	N=102		N=128	

Test Mastery Results

of 15 or More

Target Group	Comparison Group
80 of 102 Subjects or 78.4% of the Sample	28 of 128 Subjects or 21.8% of the Sample

Appendix G:

Posttest Scores for Individual

Objectives 1990

Appendix G

Comparison of Individual Skill Averages for Posttest Results

	Objective	% of Target Grp.	% of Comparison Group	% of Difference
1.	Add/Sub.Int.	74	57	17
2.	Mul./Div.Int.	80	61	19
3.	Solve Whole Number Eqts.	93	78	15
4.	Inequalities	87	22	65
5.	Absl.Value Equations	64	18	46
6.	Square/Square Roots	99	86	13
7.	Pythagorean Theory	95	48	47
8.	Solve Expressions	95	77	18
9.	Solve Ordered Pairs	68	64	4
10.	Word Problems Equations	74	30	44
11.	Unknown Base Percents	85	69	16
12.	Unknown Part Percents	95	85	10

Appendix G - Continued

Objective	% of Target Grp.	% of Comparison Group	% of Difference
13. Word Problems Proportions	88	77	11
14. Change Fractions to Decimals	95	86	9
15. Find Volume	67	45	22
16. Solve Rational Equations	55	27	28
17. Word Probl. Tax-Discount	58	40	18
18. Scientific Notations	94	73	21
19. Word Prob. Fract. and Decimals	90	72	18
20. Mean, Median, Mode	80	27	53

The numbers shown are the percent of the target and comparison group samples which showed posttest mastery of the individual objectives.

Target Group = 102 subjects.

Comparison Group = 128 subjects.

Appendix H:

Target Group Posttest Results

For Outcome Two

Appendix H

Target Group Posttest Mastery Percentages for Seven Conceptually Difficult Objectives

	Objective	% of 89 Results	% of 90 Results	% of Increase	Goal
4.	Solve Inequalities	32	87	55	Yes
5.	Absolute Value Equations	48	64	16	No
10.	Word Problems Equations	49	74	25	Yes
15.	Find Volumes	54	67	13	No
16.	Solve Rational Equations	54	55	1	No
17.	Word Problems Tax-Discount	52	58	6	No
20.	Find Mean, Median, and Mode	49	78	29	Yes

Objectives Number 5, 15, 16, and 17 were labeled by the researcher as being more difficult in nature for the students of this age group.

Appendix I:

Comparison of Groups' Posttest

Results on Outcome Two

Appendix I:

Comparison of Target and Comparison Group Posttest Differences on Seven Conceptually Difficult Objectives

Objective	% of Target Group Mastery	% of Comparison Group Mastery	Differences in Mastery
4. Inequalities	87	22	65
5. Absolute Value	64	18	46
10. Word Problems Equations	74	31	43
15. Find Volumes	67	45	22
16. Solve Rational Equations	55	27	28
17. Word Prob. Tax-Discount	58	40	18
20. Find Mean, Median, Mode	78	27	51

Appendix J:

Posttest Measurements of

Practical Significance 1990

Appendix J

Practical Significance of Posttest Results

Target Group	Comparison Group
$N = 102$	$N = 128$
$\pounds X = 1{,}663$	$\pounds X = 1{,}462$
$\overline{X} = 16.30$	$\overline{X} = 11.42$
$\pounds X^2 = 27{,}907$	$\pounds X^2 = 18{,}330$
$\overline{X}^2 = 265.69$	$\overline{X}^2 = 130.42$
$s = 2.81$	$s = 3.57$

Practical Significance Calculation

Step 1.

16.30 (Target Group Mean)
- 11.42 (Comparison Group Mean)

4.88 (Difference in Group Means)

Step 2. Difference in Group Means (4.88) Divided by the larger standard deviation of the comparison group equals 1.37 of a standard deviation in practical significance.

*Symbols Used in the Tables

- N (Number of Students)
- $\pounds X$ (Sum of the Test Scores)
- $\pounds X^2$ (Sum of the squares of the test scores)
- $\overline{X}$ (Arithmetic mean)
- $\overline{X}^2$ (Arithmetic mean squared)
- s (Standard Deviation)

Formulas Used in the Tables

1. Mean $\overline{X} = \frac{\pounds X}{N}$
2. Standard Deviation $s\sqrt{\frac{\pounds X^2}{N} - X^2}$

END

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